Oceanic Surface Forcing Estimated From Spaceborne Sensors and Their Impact on Ocean Circulation Models

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Ocean circulation is largely forced by the surface fluxes of momentum and heat. The observations of these fluxes over oceans are inadequate. In the past, only climatological flux fields derived from averaging ship observations over a long period of time were available to force ocean general circulation models (OGCM), without much of the natural variability. Recently, operational numerical weather prediction models provide improved forcing fields, but they still have considerable deficiencies. The prevalent practice of relaxing the model sea surface temperature to climatology usually results in unrealistic surface heat flux. Spaceborne sensors have the potential of providing the major components of forcing fields which would excite more realistic oceanic responses. The availability of global in situ and satellite measurements of both the surface forcing and oceanic response in recent years provides a good opportunity to examine both the flux field and the OGCM.

For a period of seven years from July 1987 to June 1993, ocean surface wind stress (momentum flux) was derived from the Special Sensor Microwave Imager (SSMI) and the ERS 1 scatterometer, surface solar irradiance was estimated from the cloud information provided by the International Satellite Cloud Climatology Project, and surface latent heat flux was estimated from SSMI humidity and wind speed. The wind and thermal forcing were used to force the primitive equation Modular Ocean Model (MOM) developed at the Geophysical Fluid Dynamic Laboratory. The oceanic responses, in the form of various diagnostics exhibited by the model, were compared with in situ and satellite measurements. An attempt was made to interpret the difference in terms of model deficiencies and forcing inaccuracies. The results demonstrated that the combination of satellite observations and numerical ocean circulation model is a powerful tool to study the traditionally undersampled ocean, particularly for understanding the basin-wide oceanic responses to surface forcing.